
Appendix C — Network Queuing

Introduction

This appendix describes the queuing features and options that are available to switches which operate in a private network environment. The queuing features are

- Off-Hook Queuing (OHQ)
- Call-Back Queuing (CBQ)
- Coordinated Call-Back Queuing (CCBQ)
- Call-Back Queuing to Conventional Mains (CBQCM)

A private network consists of one or more of the following types of switch.

Meridian 1 Node

A Meridian 1 switch that is equipped with either the Basic Alternate Route Selection (BARS) or Network Alternate Route Selection (NARS) software feature packages. NARS and BARS features are described in *Basic and network alternate route selection description* (553-2751-100).

Meridian 1 Main

A Meridian 1 switch that is connected via tie trunks to a Meridian 1 Node and is equipped with the Network Signaling (NSIG) and Network Class of Service (NCOS) software packages. A Meridian 1 Main can be connected to only one Meridian 1 Node. A Meridian 1 Main may also be equipped with the BARS and OHQ features.

Conventional Main

A switch (Meridian 1 or any other type) that is connected via tie trunks to a Meridian 1 Node and is not equipped with any network-related features.

Information presented in this practice assumes the reader is familiar with the terminology and concepts of the alternate route selection capabilities as described in *Basic and network alternate route selection description* (553-2751-100).

Off-Hook Queuing

Off-Hook Queuing (OHQ) is a software feature that can be equipped at a Meridian 1 Node and/or Meridian 1 Main. The feature enables a call originator to remain off-hook for a short time (customer programmable) until a network facility for call completion becomes available at the Node or Main.

OHQ eligibility

Network calls may be placed in an OHQ if all trunk routes (entries) in the initial route set of a route list (see Note) are busy and the following criteria are met.

- At least one of the trunk routes in the initial route set of a route list is defined as being eligible for OHQ.
- The Network Class of Service (NCOS) of the call originator (at a Node or a Main) is defined to permit OHQ.
- The incoming trunk group at the Node or the Main is defined in software to permit OHQ for incoming calls.
- The Traveling Class Mark (TCM) received at the Node from an Electronic Tie Network (ETN) switch is compatible with a Facility Restriction Level (FRL) that is defined to permit OHQ.
- The Traveling Class of Service (TCOS) received at the Node from another Node is compatible with an FRL that is defined to permit OHQ.
- The probability that the call will timeout in the OHQ before a trunk becomes available is below a specific threshold.
- The OHQ feature is enabled for the customer.

A Meridian 1 defined initial set “marker” determines which route list entries are in the initial route set. Typically, the initial route set contains the cheaper routes to a particular destination. The remaining routes in the route list (if any) comprise the extended route set and are usually the more expensive routes to the destination. Only routes in the initial route set should be defined to allow OHQ. OHQ will not be offered by routes in the extended route set even if they are defined to allow OHQ.

Calls which do not meet the preceding requirements for OHQ eligibility may be offered CBQ at this point.

OHQ availability

The OHQ software performs an “availability” test to prevent calls from entering the OHQ when there is a high probability that the call will timeout before a trunk becomes available. The following procedure is used to make this test.

- For each trunk route, a counter is maintained which reflects the current number of calls with the maximum queue priority of 3 queued against it. (This includes all calls in OHQ and those CBQ and Ring Again calls that are currently at priority 3.)
- Each trunk route has a threshold value which indicates the maximum number of priority 3 calls that can be queued against it before OHQ timeout becomes a high probability. Before a call is placed in the OHQ the current queue count is compared with the threshold value for each eligible trunk route in the initial set of routes. If at least one of the trunk routes has a count which is less than or equal to the threshold value, the call is allowed to OHQ against all OHQ-eligible routes.

OHQ offer

If all eligibility and availability checks are successful, the call originator is given a distinctive OHQ offer tone (a 1s burst of 440 Hz tone) when the call enters the OHQ. The call originator either accepts the OHQ offer by remaining off-hook, or declines the offer by going on-hook.

OHQ calls are placed in a priority-ordered queue with all other calls waiting for trunks. OHQ calls are assigned maximum priority (3) because other network facilities may be held while the call is queued. A timer with an initial value equal to the software-defined OHQ time limit is started to limit the duration of the OHQ. (The OHQ time limit is service changeable within the range of 2 to 60 s.)

The queue is examined whenever a trunk becomes idle in a trunk route on which one or more calls are queued. If a call is found which can be terminated on an idle trunk, the available trunk is seized and the call terminated.

If the OHQ timer expires before the call can be terminated, the call is removed from the OHQ. At this time, the remaining eligible routes in the route list (the extended set) are examined and the call is either terminated or given standard blocking treatment if no facilities are available. (CBQ will not be offered at this point as OHQ was already offered.) Expensive Route Warning (ERWT) is not given to calls which have been queued even if terminated on expensive facilities.

OHQ can be offered to call originators located at a Node, Main, Conventional Main or ETN switch. Also, as a call progresses through the network, OHQ can be offered to the call originator from any of the Nodes or Mains that are used to process the call (i.e., OHQ can be offered more than once for a given call).

OHQ traffic measurements

Traffic measurement data related to usage of the OHQ feature is accumulated at a Node or Main that is equipped with Network Traffic (NTRF) feature. Data for OHQ usage is available in the publication *Traffic measurement* (553-2001-450).

Routing measurements (TFN001)

Available at a Node or Main. Reflects on a route list basis the number of calls placed in the OHQ, the average time a call waited in the OHQ and the number of calls abandoned while in the OHQ.

NCOS measurements (TFN002)

Available at a Node or Main. Reflects on a NCOS basis the number of call placed in the OHQ and the average time a call waited in the OHQ.

Incoming trunk group measurements (TFN003)

Available at a Node. (The measurements are also available at a Main if the OHQ feature is equipped and some incoming trunk groups are defined as OHQ eligible.) Reflects on an incoming trunk (or two-way) trunk group basis the number of calls placed in the OHQ and the average time a call waited in the OHQ.

Feature interactions

The OHQ feature has the following interactions with existing Meridian 1 features.

Call modification

Station users are not allowed to activate call modification features (hold, call transfer, conference) while waiting in the OHQ. Switchhook flash used to activate features from 500/2500 sets is ignored. Similarly, operation of SL-1 or digital set feature keys is ignored.

Camp-on, call waiting

If the attendant extends a call to a station that is in the OHQ, the call-waiting tone is not offered to the station. If the attendant releases, the call is camped-on the OHQ station but no warning tone is given. When the camp-on call is recalled to the attendant console, the attendant can repeat the camp-on procedure. Once the OHQ call is in an established state, the camp-on tone is provided.

Attendant functions

- Attendant cannot barge-in during trunk seizure for OHQ calls.
- If the attendant extends a network call for a station user and the call is offered OHQ, the attendant must inform the caller of the OHQ offer before releasing from the call.
- The attendant is not allowed to operate the release key or another loop key if the source call is in conference and the destination call is in the OHQ. Operation of the release destination key is permitted, however, and causes the OHQ call to be abandoned.

Call-Back Queuing

Call-Back Queuing (CBQ) is a Node feature which provides queuing for network calls which encounter busy or blocked facilities at the Node. CBQ enables the calling party to go on-hook after activation of the Ring Again feature [see *Features and services* (553-3001-305)] and receive a callback from a Node when a network facility becomes available.

The CBQ feature is available only to stations located at a Node. Unlike OHQ, CBQ is offered only at the originating Node. Access to CBQ is accomplished through the existing Ring Again feature.

CBQ options

Two options for CBQ eligibility are defined by the call originator's NCOS. The first option, CBQ(i), means the CBQ may be offered after only the initial route set of a route list has been examined for an available route. The second option, CBQ (a), means that CBQ may be offered after both the initial and extended (i.e. all) route sets of a route list have been examined. In either case, a call offered CBQ is queued initially against only the initial route set.

CBQ eligibility

Before offering CBQ to a call originator, the following eligibility tests are performed.

- At least one of the routes in the initial route set is defined as CBQ eligible.
- The user's NCOS is defined as permitting CBQ, either CBQ(i) or CBQ(a).
- The call is not eligible for OHQ. Calls that are eligible for both OHQ and CBQ will be offered OHQ.
- The user's telephone is allowed access to the Ring Again feature and does not have another CBQ or Ring Again call already in the queue.
- The CBQ feature is enabled for this customer.

CBQ(i) eligible

For call originations by a caller defined as CBQ(i) eligible, the system searches the initial route set for an available route. If no available route is found, CBQ is offered to the caller subject to the CBQA eligibility tests.

CBQ(a) eligible

For call originations by a caller defined as CBQ(a) eligible, the system examines the initial route set for an available route. If no available route is found, the extended route set is then searched for an available route. If an available route is not found in the extended set, then CBQ is offered, subject to the CBQ eligibility tests. However, if an available route in the extended route set is found that is designated as expensive, and the user's NCOS allows ERWT, the tone is given and the system delays terminating the call. During this delay the user has the following options.

- Refuse the expensive route by abandoning the call.
- Wait, and allow the call to complete over the expensive route.
- Activate the Ring Again feature (feature key or access code) to place the call in the CBQ. The user must be CBQ(a) eligible; otherwise, operation of the Ring Again feature is ignored.

CBQ offer

The CBQ offer consists of an optional recorded announcement followed by overflow tone. If the station user wishes to accept the CBQ offer, Ring Again must be activated within 30 s. Ring again activation follows present feature operation for SL-1 or digital and 500/2500 sets [see *Features and services* (553-3001-305)]. The CBQ offer can be refused by going on-hook. If the station user neither accepts nor refuses the CBQ offer within 30 s, the call is force disconnected.

CBQ calls are placed in a priority-ordered trunk queue (together with OHQ calls, if any) with a starting priority and maximum priority defined by the call originator's NCOS. At the same time, two timers are started — a queue promotion timer and a route advance timer — each with values defined through the originator's NCOS. At intervals defined by the queue promotion timer, the priority of the call is incremented until it reaches its maximum priority. Each time the call priority is incremented, its position in the CBQ is advanced. If the route advance timer reaches its maximum value before the call can be terminated on a route in the initial set, the extended set or routes is added to the routes that the call is currently queued against.

Expensive route warning tone is not given to calls which have been queued, even if terminated on expensive facilities. Unless canceled by the call originator, CBQ calls remain in the queue until they have been offered a trunk; there is no time limit on CBQ calls.

CBQ callback

When a trunk becomes available for a CBQ call, it is seized to prevent incoming originations during the CBQ callback period. Outpulsing of digits (either those originally dialed by the user or those required as a result of digit manipulation) is started at a slow, fixed rate. The number of digits to be outpulsed determines how long the trunk can be held while CBQ callback is being offered to the originating station. The system computes this time by allowing 10 s before the first digit is outpulsed at 2.56 s between subsequent digits.

The originator of the call is alerted to the CBQ callback by either tone buzzing and winking ring again feature lamp (SL-1 or digital set) or short bursts of ringing (500/2500 set). The set user must accept the callback within the computed value of outpulse time or the service-changeable CBQ time limit of 10 to 30 s, whichever is less. A user with a 500/25000 set must accept the callback within 6 s. Acceptance of the CBQ callback is performed with present Ring Again operating procedures. (When a CBQ callback is answered at a digit display set, the original dialed digits are displayed.) If the user does not answer the callback within the time limit, the call is removed from the queue and discarded. If the user accepts the callback within the time limit, the call is terminated. A CBQ call can be canceled by the originating station via the existing procedures for Ring Again cancellation.

CBQ traffic measurements

Traffic measurement data related to the usage of the CBQ feature is accumulated at a Node or Main equipped with the Network Traffic (NTRF) feature. Data for CBQ usage is available in the publication *Traffic measurement* (553-2001-450).

Routing measurements (TFN001)

Available at a Node or Main. Reflects on a route list basis the number of CBQ offers, the number of CBQ callbacks, the average time in the CBQ and the number of CBQ cancellations.

NCOS measurements (TFN002)

Available at a Node or Main. Reflects on an NCOS basis the number of CBQ calls and the average time in the CBQ.

Feature interactions

The CBQ feature interacts with the following features.

Barge-In, force disconnect

Between the time a trunk is seized for a CBQ call and the user accepts the CBQ callback, the trunk can be stolen by the attendant or force disconnected through service change. If this occurs, there is no guarantee that the call can be terminated when the user accepts the CBQ callback. Under these circumstances, the call is treated like a new origination and NARS/BARS is used to re-attempt termination. This can result in the call being blocked and being offered CBQ a second time.

Hunting, call forward, multiple appearance DN

CBQ callbacks to stations at a Node are offered only to the originating station, regardless of the hunting or call forwarding which may be in effect. Other appearances of a station's Directory Number (DN) are not offered the callback.

Coordinated Call-Back Queuing

The Coordinated Call-Back Queuing (CCBQ) feature enables stations at a Meridian 1 Main to be offered CBQ when network calls are blocked at the serving Meridian 1 Node. When facilities become available at the Node, the call originator at the Main is alerted by a callback from the Node. (This feature requires that Main and associated Node be equipped with the network signalling feature).

CCBQ eligibility

When a station at a Main originates a network call through a Node, the NCOS of the call originator, call type, and whether the station is allowed access to the ring again feature is transmitted to the Node. (If an authcode is entered at the Main prior to dialing a network call, the NCOS associated with the authcode is transmitted to the Node.) When received by the Node, this NCOS is used to determine CCBQ eligibility and is used for the duration of the call, unless further modified by the Authcode Conditionally Last feature [see *Basic and network authorization code description* (553-2751-103)].

The CBQ eligibility tests are performed. In addition, a check is made that the incoming trunk group from the Main is defined (at the Node) to permit CBQ and that the type allows CBQ. CCBQ is offered to the user at the Main if the eligibility tests are successful. If the tests are unsuccessful, standard call blocking is applied to the call.

As for stations at a Node, the call originator at a Main can invoke Ring Again upon receipt of ERWT if the originator's NCOS is defined at the Main as CBQ (a) eligible.

CCBQ offer

The CCBQ offer and acceptance sequences are identical to those for stations at the Node (SBQ offer). The optional recorded announcement and overflow tone are provided by the Node. The offer cannot be accepted until the recorded announcement is completed and the offer tone is started. In addition, after the recorded announcement is provided, the Node transmits a signal to the Main. This signal indicates that the call is in a state which allows Ring Again.

When the call originator at the Main activates ring again the Main assigns a unique “queue identification” number to the call. This number is transmitted to the Node to indicate CCBQ acceptance. At the Main, the call is placed in a holding queue. At the Node, the call (together with the queue identification number) is placed into the trunk queue. The Main to Node tie trunk is released.

CCBQ callback

When an outgoing trunk is seized by the Node for a CCBQ call, slow outpulsing is started to hold the trunk while a callback is made to the call originator at the Main. The Node seizes an available (note) tie trunk to the Main and transmits the “queue identification” number of the call to the Main. The Main then initiates a callback to the call originator. Callback presentation to the call originator is as for standard ring again (CBQ callback).

If no tie trunks to the Main are available, the outgoing trunk is released and can be offered another call. The CCBQ call retains its position in the queue but is not offered another trunk until a tie trunk to the Main becomes available.

When the call originator at the Main accepts the CCBQ callback, answer supervision is sent from the Main to the Node. The Node then completes the call.

If the call originator is equipped with a 500/2500 set and is engaged in a call when the Node initiates a CCBQ callback, a signal is transmitted from the Main to the Node. The Node releases the outgoing trunk and places the CCBQ call into a holding queue for 5 min. No attempt is made to seize another outgoing trunk for the call until the holding time expires. This process occurs only once.

If the originating station is still busy after the holding time has expired, the CCBQ is canceled automatically at the Node. No indication is given to the call originator of the CCBQ cancellation.

To prevent the CCBQ call from remaining indefinitely in the holding queue at the Main, the Main sets a time limit of one hour for CCBQ calls. When this time limit expires, the CCBQ call is canceled automatically. (CCBQ callback to a busy station is as for normal Ring Again).

The call originator at the Main can cancel the CCBQ call at any time. The Node is not aware of the cancellation until the CCBQ callback is attempted.

CCBQ traffic measurements

Traffic measurement data related to usage of the CCBQ feature are accumulated at the Node. The data is reflected in the Incoming Trunk Group Measurements (TFN003). The measurements reflect, on an incoming trunk group basis, the number of CCBQ offers, the number of CCBQ offers that are accepted and the number of CCBQ callbacks not answered or CCBQ cancellations. [Refer to *Traffic measurement* (553-2001-450).]

Feature interactions

The CCBQ feature interacts with the following Meridian 1 features.

Initialization

If the Main initializes while calls are queued at the Node, CCBQ callbacks from the Node are not answered because the initialization has cleared the holding queue at the Main. The Node treats these calls as callback-no-answer calls and cancels the CCBQ automatically. If the Node initializes, CCBQ calls in the trunk queue are lost. The Main cannot detect this situation. To prevent calls from remaining indefinitely in the holding queue at the Main, Main sets a time limit of one hour for CCBQ calls. If a call back from the Node is not received within one hour, the Main cancels the CCBQ calls automatically.

Attendant functions

Attendants at a Main are not offered CCBQ. Attendant barge-in on trunks involved in CCBQ operations results in cancellation of the CCBQ call.

AIOD and ANI

Automatic Identification of Outward Dial (AIOD) and Automatic Number Identification (ANI) facilities can be used to complete CCBQ calls from a Node. The outgoing toll call is billed to the access tie trunk rather than the station at the Main.

Coordinated Dialing Plan

If CCBQ is offered to a CDP call as a result of trunk blocking at the Node, the optional recorded announcement is not given before the CCBQ offer tone.

Call transfer, conference

Stations at a Main can be offered CCBQ when initiating transfer or conference calls. CCBQ is not offered to 500/2500 stations performing these operations.

Feature limitations

A station at a Main is only allowed 10–12 s to activate ring again after the CCBQ offer (or ERWT) rather than the 30 s allowed for stations at the Node. Accordingly, the time interval of the recorded announcement (if provided) must be properly engineered to ensure that the station at the Main has time to activate CCBQ when it is offered.

The time available to answer a CCBQ callback at stations at a Main is 2–3 s less than the time available to stations at the Node, due to the time required for access trunk seizure and signaling.

Tie trunk groups used to provide CCBQ to a Main cannot be arranged for loop start dial repeating signaling and cannot have joint far-end disconnect control as these arrangements do not allow the call to be disconnected after a CCBQ callback.

Tones and recorded announcements used for CCBQ to users at a Main are provided by the Node. Traffic loads imposed on these facilities at the Node must be considered when engineering Nodes.

Call-Back Queuing to Conventional Mains

The Call-Back Queuing to Conventional Mains (CBQCM) feature enables call originators at a Conventional Main to access the CBQ feature at a Node.

CBQCM eligibility

When a station at a Conventional Main originates a network call through a Node, the NCOS assigned to the incoming trunk group is used to determine the CBQCM eligibility. This NCOS, as well as the incoming trunk group, must be defined as CBQ eligible.

If the call originates from an ETN switch, the Traveling Class Mark (TCM) transmitted to the Node, by the ETN switch, must be compatible with a CBQ-eligible Facility Restriction Level (FRL) at the serving Node.

CBQCM offer

The CBQCM offer to call originator at a Conventional Main consists of an optional recorded announcement, followed by special (interrupted) dial tone. (The announcement and tones are provided from the Node.) To accept the CBQCM offer, the call originator dials the extension number associated with the telephone being used for the call. When the last digit of the extension number is dialed, a confirmation tone (three 256 ms bursts of dial tone) is sent from the Node to the call originator. The call is placed in the CBQ at the node when the call originator goes on hook.

The CBQCM offer can be refused by going on-hook any time before the last digit of the extension number is dialed or by remaining off-hook for longer than 30 s after receipt of the confirmation tone. If the CBQCM is neither accepted nor rejected within 30 s, the caller is given overflow tone (from the Node) and the call is disconnected.

CBQCM callback

When an outgoing trunk becomes available at the Node, it is seized and slow outpulsing is started. The Node then seizes a tie trunk (See Note) to the conventional main and outpulses the extension number of the call originator. The call originator must answer the callback before slow outpulsing is completed; otherwise, the callback is canceled and the outgoing trunk is released.

If no tie trunks are currently available to the conventional main, the Node releases the outgoing trunk. The CBQCM call retains its position in the queue but is not offered another outgoing trunk until a tie trunk to the Conventional Main becomes available.

When the call originator answers the CBQCM callback, answer supervision must be transmitted from the Conventional Main to the Node. Upon receipt of answer supervision from the Conventional Main, the Node transmits a tone (three 256ms bursts of dial tone) to notify the call originator that the call is a CBQCM callback, and completes the call.

If the call originator's station is busy, or the originator does not answer when the callback is placed, the Node places the call in a suspended state for 5 min. After 5 min., another callback is attempted if the outgoing trunk is free. If the station which originated the call is still busy or does not answer, the Node cancels the call.

No provision is made for CBQCM cancellation by a call originator at a Conventional Main. Once the CBQCM offer is accepted, the call remains in the queue until the Node initiates a callback.

CBQCM traffic measurements

Traffic measurement data related to usage of the CBQCM feature are accumulated at the Node. This data is outputted as part of the Incoming Trunk Group Measurements (TFN003). The data reflects on an incoming trunk group basis the number of the CBQCM offers and acceptances, average time in CBQCM, number of blocked CBQCM callbacks and the number of CBQCM callbacks not answered.

Feature limitations

Station users at Conventional Mains cannot activate Ring Again to refuse expensive routes after the Expensive Route Warning Tone (ERWT) is given.

The Node seizes the same tie trunk group that was used to initiate CBQCM for the CBQCM callback. Thus, these trunk groups must be two-way (incoming/outgoing).

Conventional Mains must provide answer supervision on tie trunks connected to the Node. These switches must also permit transmission or repetition of station dial pulses for CBQCM operation. This feature cannot be used with systems that operate in senderized mode. Operation may require adjustment of the interdigit timeout on systems that employ simulated cut-through operation.

Conventional Mains must not allow CBQCM callback calls to be modified by call transfer or call forward. Such call modification can result in the tie line not being released upon call completion.

The station user at a Conventional Main must dial the internal DN of his/her station to accept a CBQCM offering, rather than the CDP-DN, if the Node is equipped for the Coordinated Dialing Plan.

Tie trunk groups used to provide CBQCM to a Conventional Main cannot be arranged for loop start dial repeating signaling and cannot have joint far-end disconnect control as these arrangements do not allow the call to be disconnected after a CBQCM callback.

Because tones and recorded announcements for CBQCM are provided by the Node, traffic loads on these facilities at the Node must be considered when engineering Nodes.

Coordinated Call-Back Queuing Against Mains

The Coordinated Call-Back Queuing Against Mains (CCBQAM) feature enables stations at Nodes to be offered CBQ for network calls which are blocked at a Main. When facilities become available at the Main, the call originator at the Node is alerted by a callback from the Main. The CCBQAM otherwise functions identically to CCBQ at the Node.

Meridian 1

Option 11C

2.0 Mb DTI/PRI Administration and Maintenance guide

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